NIVeL: Neural Implicit Vector Layers for Text-to-Vector Generation
-Supplementary Material-

1. Additional Ablations
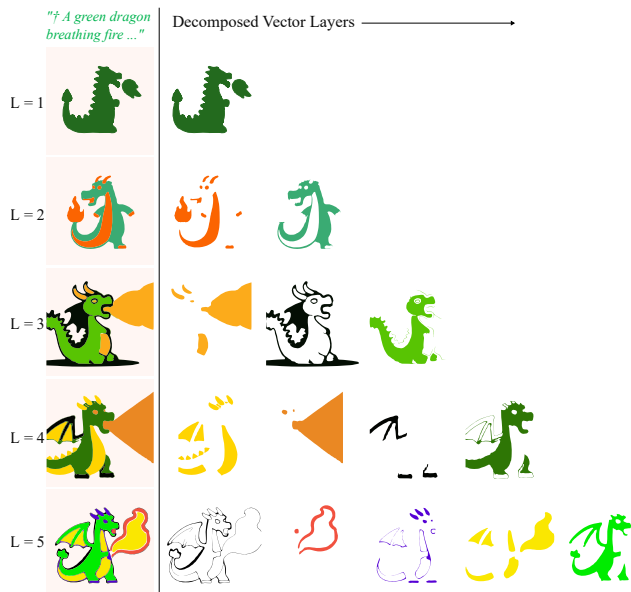

Figure 1. For the given input text prompt we show our generated results changing only the value of L (the number of output decomposed layers). †: "... minimal 2D vector art, lineal colors"

Effect of number of layers L. The number of decomposed layers generated by our system is set by the hyperparameter L. In Figure 1, we show the effect on the generated results for values of L ranging from 1 (minimum) to 5 (default value in our experiments). We fix the prompt and all other settings for all results. Our method can generate plausible shapes and colors under each constrained setting. We observe presence of distinguishable semantic parts as the number of layers L increase.

Effect of random seeds. Figure 2 and 3 show the stochasticity of the results achieved by changing the random seed of the image diffusion model.
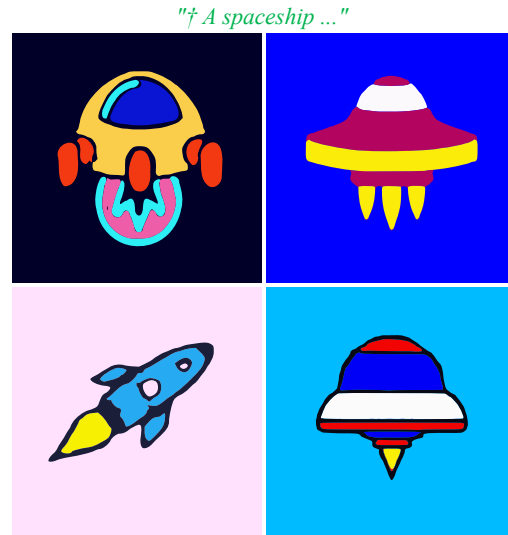

Figure 2. The effect of changing the random seed for the given input text prompt. †: "... minimal 2D vector art, lineal colors"

2. Qualitative Results

In Figure 4 we compare NIVeL (ours) vs VectorFusion for a line drawing style. Since the style involves shape outlines or contours, here we use a single layer ($L = 1$). For the rest of the hyperparameters, we set $F = 6$ octaves in the positional encoding, and the MLP architecture has $12K$ parameters. For VectorFusion, we use 256 paths each containing upto 5 Bézier curves for a total of also $12K$ parameters. We visualize the generated SVGs without the curve fill attribute to demonstrate the accuracy and smoothness of our produced line drawings of shapes compared to VectorFusion's results which contain redundant overlapping and self-intersecting lines.

3. Visualization of SDS gradients

The SDS gradients provided by the frozen pre-trained diffusion model contain rich and visually interpretable signals for shape generation. In Figure 5 and Figure 6, we show the SDS gradients visualized as an RGB image (1st row) and the generated images (2nd row) across a subset of the 8000 optimization steps. In Figure 5, we initialize one layer
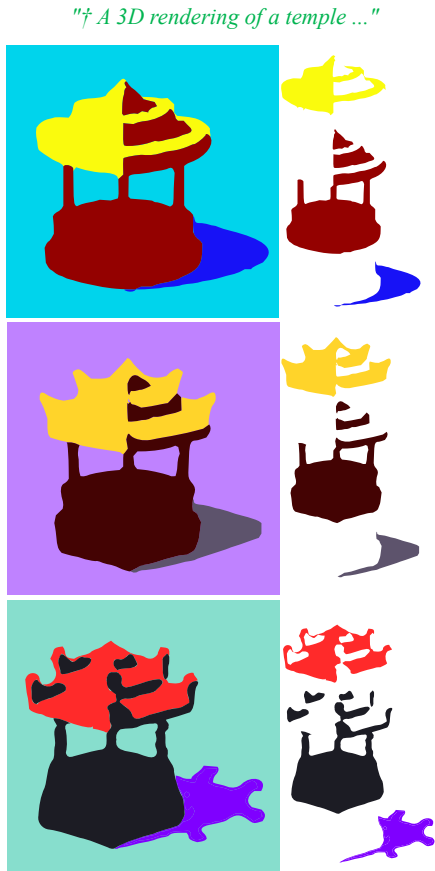
1

"† A 3D rendering of a temple ..."

Figure 3. Rich priors learned by the image diffusion model are preserved in our generated shapes. Specifically, the shape of the shadow matches the style and structure of the roof of the temple across the three shown synthesis runs. Each generation uses a different random seed. †: "... minimal 2D vector art, lineal colors"

Hyperparameters	
Guidance scale	14.0
t (timestep)	$\sim \mathcal{U}(0, 1)$
L	5
Iterations	8000
Learning rate (Color)	$5e^{-3}$
Batch size	3
λ	$1e^{-5}$
λ'	$1e^{-4}$

12K Model	
F	6
Layers	4
Hidden nodes	64
Activation	LeakyReLU
Learning rate (MLP)	$1e^{-2}$

1K Model	
F	2
Layers	3
Hidden nodes	32
Activation	LeakyReLU
Learning rate (MLP)	$1e^{-3}$

Table 1. Model cards of NIVeL's variants used in our experiments.

4. Implementation details

Table 1 provides more details on the architecture variants of the NIVeL's MLPs along with hyperparameters used in our experiments.

5. User study details

Figure 7 shows a screenshot of the webpage containing an example question used in our perceptual evaluation questionnaires. Each questionnaire was released via the MTurk platform. It contained 10 unique questions, each asking for one comparison between NIVel and VectorFusion. Then these 10 questions were repeated in the questionnaire in a random order. In these repeated questions, the order of compared illustrations was flipped. If a worker gave more than 3 inconsistent answers for the repeated questions, then he/she was marked as "unreliable". Each participant was allowed to perform the questionnaire only once. The results are shown in Figure 6 of the main text.

6. List of prompts used in our experiments

Below we show all the text prompts used in our comparisons with VectorFusion (including our user study), as discussed in the main text.

with a Gaussian blob and show the evolution of the generated shape during the optimization. Note the ability of our representation to freely add or remove holes i.e change genus. Our entropy-based loss helps in producing clean boundaries. Similarly, in Figure 6, we show these effects on multi-layer generations. We set the initialized layers to be either 2D boxes or ellipses. The choice of these two initialization procedures allows an easier interpretation of the gradient signals. This also demonstrates that the initialization for NIVeL can be handcrafted, if desired. For the two prompts, *"A grizzly bear karate master..."* and *"A flamingo karate master..."*, one can observe the effect of the initialization not just on the generated shapes during the optimization but also in the SDS gradients. These two initialization show the different outcomes explored via SDS and how geometric properties of the initial shapes are preserved i.e., the presence of sharp corners with the boxes.
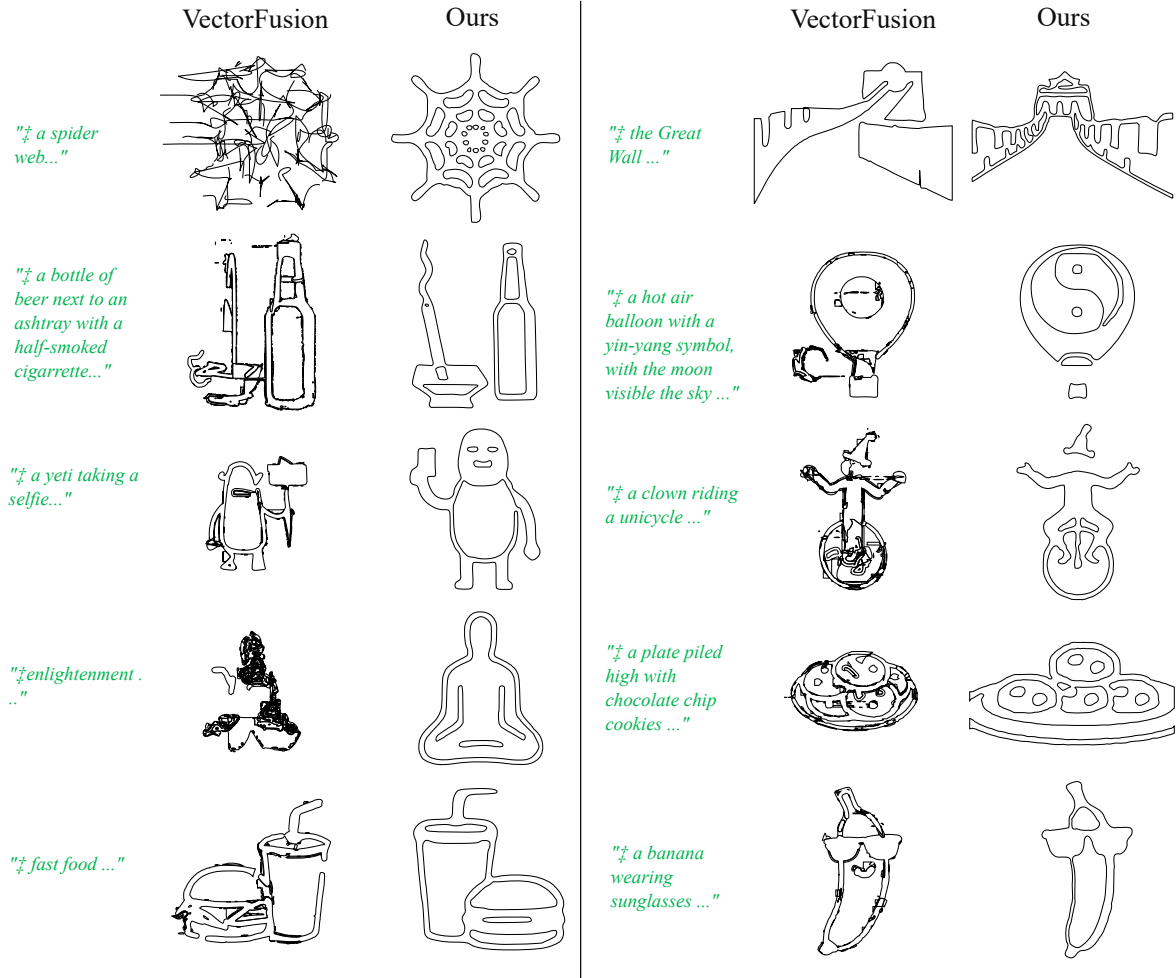
Figure 4. Text-to-Vector Graphics generation results. We compare generated SVG results for the input text prompt between NIVeL (ours) vs VectorFusion . Our vector results contain much cleaner shape geometry across diverse topology while VectorFusion's SVGs contain redundant, degenerate curves, and self-intersecting shapes. ‡: "Line drawing of ... black and white"

"Line drawing of Third eye, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a baby penguin, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a ladder, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a crown, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A cat as 3D rendered in Unreal Engine, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Fast Food, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Happiness, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Family vacation to Walt Disney World, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a bottle of beer next to an ashtray with a half-smoked cigarrette, minimal 2d line drawing, on a white background, black and

white"

"Line drawing of A Japanese woodblock print of one cat, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A torii gate, minimal 2d line drawing, on a white background, black and white"

"Line drawing of an elephant, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A spaceship flying in a starry sky, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Enlightenment, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A 3D rendering of a temple, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a fire-breathing dragon, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A realistic photograph of a cat, minimal 2d line drawing, on a white background, black and white"

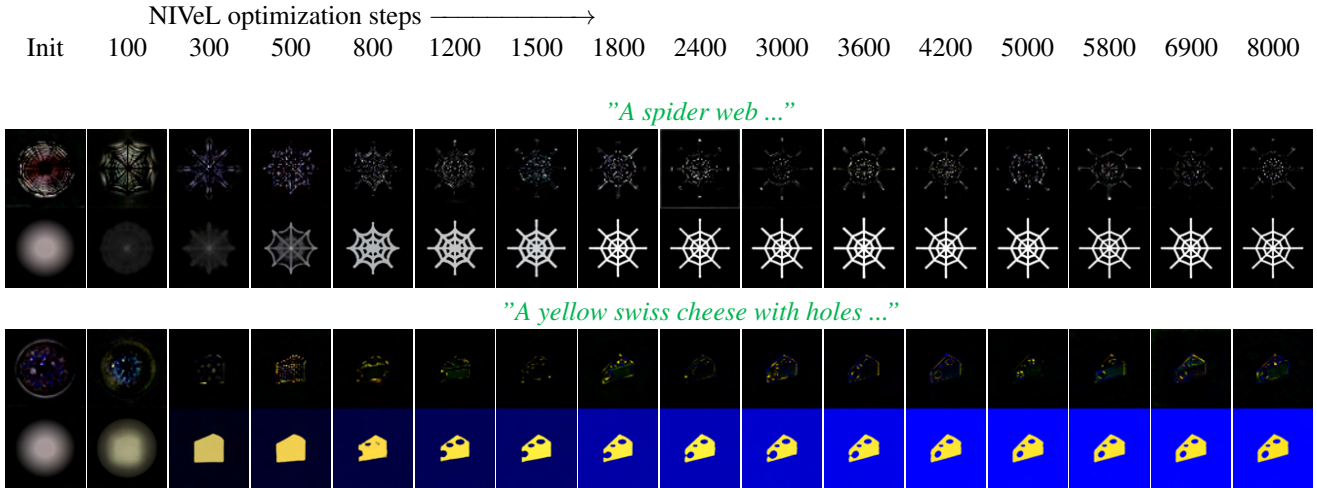"Line drawing of a tree, minimal 2d line drawing, on a white background,

NIVeL optimization steps ———————→
Init 100 300 500 800 1200 1500 1800 2400 3000 3600 4200 5000 5800 6900 8000

"A spider web ..."

"A yellow swiss cheese with holes ..."

Figure 5. We visualize the SDS gradients in rgb color space (1st row) and generated results (2nd row) during optimization for two prompts. Initialization (Init) is the leftmost column. Columns on its right show the generated result and gradients for the ith optimization step. The number of layers is $L = 1$ here.

NIVeL optimization steps ———————→
Init 100 300 500 800 1200 1500 1800 2400 3000 3600 4200 5000 5800 6900 8000

Box

"A grizzly bear karate master ..."

Ellipse

Box

"A flamingo karate master ..."

Ellipse

Figure 6. We visualize the SDS gradients in rgb color space (1st row) and generated results (2nd row) during optimization for two prompts. Initialization (Init) is the leftmost column. Columns on its right show the generated result and gradients for the ith optimization step. The number of layers is $L = 3$ here.
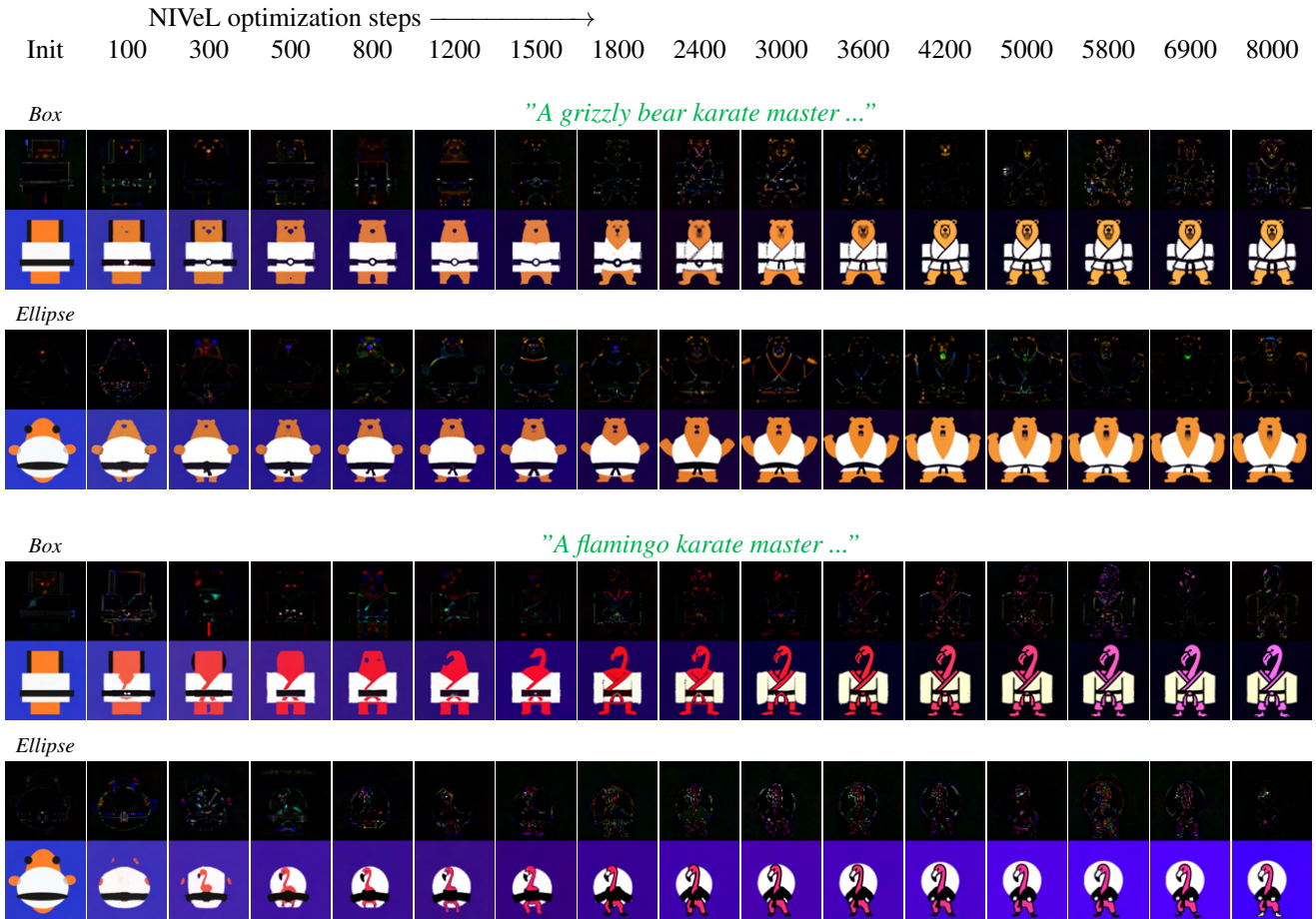
Figure 7. Screenshot of an example question used in our MTurk questionnaires.

black and white"

"Line drawing of a hot air balloon with a yin-yang symbol, with the moon visible in the daytime sky, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A 3D wireframe model of a cat, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Hashtag, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Yeti taking a selfie, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A dragon-cat hybrid, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a tall horse next to a red car, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Underwater Submarine, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A drawing of a cat, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a photograph of a fiddle next to a basketball on a ping pong table, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Forest Temple as 3D rendered in Unreal Engine, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Horse eating a cupcake, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A realistic painting of a sailboat, minimal 2d line drawing, on a white background, black and white"

"Line drawing of the Great Wall, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a boat, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A watercolor painting of a cat, minimal 2d line drawing, on a white background, black and white"

"Line drawing of The space between infinity, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a basketball to the left of two soccer balls on a gravel driveway, minimal 2d line drawing, on a white background, black and

white"

"Line drawing of The Eiffel Tower, minimal 2d line drawing, on a white background, black and white"

"Line drawing of A painting of a starry night sky, minimal 2d line drawing, on a white background, black and white"

"Line drawing of Translation, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a triangle, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a circle, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a dragon breathing fire, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a group of squirrels rowing crew, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a fox and a hare tangoing together, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a plate piled high with chocolate chip cookies, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a walrus smoking a pipe, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a stork playing a violin, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a match stick on fire, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a friendship, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a banana with sun glasses, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a clock with dials, minimal 2d line drawing, on a white background, black and white"

"Line drawing of a classic wristwatch, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a vintage camera, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a coffee cup and saucer, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a Clown on a unicycle, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a Utah teapot, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a computer vision conference, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a Science conference, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a human hand, Minimal 2D line drawing, On a white background, black and white"

"Line drawing of a still life, Minimal 2D line drawing, On a white background, black and white"

"A 3D wireframe model of a cat, minimal 2D vector art, lineal color"

"a bottle of beer next to an ashtray with a half-smoked cigarrette, minimal 2D vector art, lineal color"

"A human hand, minimal 2D vector art, lineal color"

"A dragon breathing fire, minimal 2D vector art, lineal color"

"A group of squirrels rowing crew, minimal 2D vector art, lineal color"

"A fox and a hare tangoing together, minimal 2D vector art, lineal color"

"A plate piled high with chocolate chip cookies, minimal 2D vector art, lineal color"

"A walrus smoking a pipe, minimal 2D vector art, lineal color"

"A stork playing a violin, minimal 2D vector art, lineal color"

"A match stick on fire, minimal 2D vector art, lineal color"

"A tiger karate master, minimal 2D vector art, lineal color"

"a squirrel dressed up like a victorian woman, lineal color"

"A baby bunny sitting on top of a stack of pancakes, minimal 2D vector art"

"A baby python sitting on top of a stack of books, minimal 2D vector art"

"A vintage camera, minimal 2D vector art, lineal color"

"A coffee cup and saucer, minimal 2D vector art, lineal color"

"A Clown on a unicycle, minimal 2D vector art, lineal color"

"A still life, minimal 2D vector art, lineal color"

"A banana with sun glasses, minimal 2D vector art, lineal color"

"A clock with dials, minimal 2D vector art, lineal color"

"A classic wristwatch, minimal 2D vector art, lineal color"

"A Utah teapot, minimal 2D vector art, lineal color"

"A computer vision conference, minimal 2D vector art, lineal color"

"A Science conference, minimal 2D vector art, lineal color"

"A friendship, minimal 2D vector art, lineal color"

"A tree, minimal 2D vector art, lineal color"

"A hot air balloon with a yin-yang symbol, with the moon visible in the daytime sky, minimal 2D vector art, lineal color"

"Yeti taking a selfie, minimal 2D vector art, lineal color"

"A dragon-cat hybrid, minimal 2D vector art, lineal color"

"A spider web, minimal 2D vector art, lineal color"

"Underwater Submarine, minimal 2D vector art, lineal color"

"A boiling water on a fire stove, minimal 2D vector art, lineal color"

"A photograph of a fiddle next to a basketball on a ping pong table, minimal 2D vector art, lineal color"

"Forest Temple as 3D rendered in Unreal Engine, minimal 2D vector art, lineal color"

"Horse eating a cupcake, minimal 2D vector art, lineal color"

"A sailboat, minimal 2D vector art, lineal color"

"the Great Wall, minimal 2D vector art, lineal color"

"A boat, minimal 2D vector art, lineal color"

"A fluid simulation, minimal 2D vector art, lineal color"

"The space between infinity, minimal 2D vector art, lineal color"

"A basketball to the left of two soccer balls on a gravel driveway, minimal 2D vector art, lineal color"

"A triangle, minimal 2D vector art, lineal color"

"A circle, minimal 2D vector art, lineal color"

"A Japanese woodblock print of one cat, minimal 2D vector art, lineal color"

"A torii gate, minimal 2D vector art, lineal color"

"An elephant, minimal 2D vector art, lineal color"

"A spaceship flying in a starry sky, minimal 2D vector art, lineal color"

"Enlightenment, minimal 2D vector art, lineal color"

"Third eye, minimal 2D vector art, lineal color"

"A baby penguin, minimal 2D vector art, lineal color"

"A ladder, minimal 2D vector art, lineal color"

"A crown, minimal 2D vector art, lineal color"

"A cat as 3D rendered in Unreal Engine, minimal 2D vector art, lineal color"

"Fast Food, minimal 2D vector art, lineal color"

"Happiness, minimal 2D vector art, lineal color"

"Family vacation to Walt Disney World, minimal 2D vector art, lineal color"

"Line drawing of A 3D wireframe model of a Monkey, 2d vector art line drawing, black and white"

"Line drawing of a bottle of beer next to an ashtray with a half-smoked cigarrette, 2d vector art line drawing, black and white"

"Line drawing of A human hand showing the peace sign, 2d vector art line drawing, black and white"

"Line drawing of A plate piled high with chocolate chip cookies, 2d vector art line drawing, black and white"

"Line drawing of A flamingo playing a cello, 2d vector art line drawing, black and white"

"Line drawing of A leopard karate master, 2d vector art line drawing, black and white"

"Line drawing of a Lizard dressed up like a victorian woman, lineal color"

"Line drawing of A vintage telephone, 2d vector art line drawing, black and white"

"Line drawing of An orange with sun glasses, 2d vector art line drawing, black and white"

"Line drawing of A duck taking a selfie, 2d vector art line drawing, black and white"

"Line drawing of A dragon-corgi hybrid, 2d vector art line drawing, black and white"

"Line drawing of Horse eating a hotdog, 2d vector art line drawing, black and white"

"Line drawing of An elephant surfing, 2d vector art line drawing, black and white"

"Line drawing of A plate of healty fast Food, 2d vector art line drawing, black and white"

"A 3D wireframe model of a Monkey, minimal 2D vector art, lineal color"

"a bottle of beer next to an ashtray with a half-smoked cigarrette, lineal color"

"A human hand showing the peace sign, minimal 2D vector art, lineal color"

"A dragon breathing fire, minimal 2D vector art, lineal color"

"A group of squirrels rowing crew, minimal 2D vector art, lineal color"

"A fox and a hare tangoing together, minimal 2D vector art, lineal color"

"A plate piled high with chocolate chip cookies, minimal 2D vector art, lineal color"

"A walrus smoking a pipe, minimal 2D vector art, lineal color"

"A flamingo playing a cello, minimal 2D vector art, lineal color"

"A match stick on fire, minimal 2D vector art, lineal color"

"A leopard karate master, minimal 2D vector art, lineal color"

"a Lizard dressed up like a victorian woman, minimal 2D vector art, lineal color"

"A baby python sitting on top of a stack of books, minimal 2D vector art, lineal color"

"A vintage telephone, minimal 2D vector art, lineal color"

"A coffee cup and saucer, minimal 2D vector art, lineal color"

"A Clown juggling balls, minimal 2D vector art, lineal color"

"A still life painting, minimal 2D vector art, lineal color"

"An orange with sun glasses, minimal 2D vector art, lineal color"

"A symbol of friendship, minimal 2D vector art, lineal color"

"A banyan tree, minimal 2D vector art, lineal color"

"A duck taking a selfie, minimal 2D vector art, lineal color"

"A dragon-corgi hybrid, minimal 2D vector art, lineal color"

"A spider web, minimal 2D vector art, lineal color"

"A Temple as 3D rendered in Unreal Engine, minimal 2D vector art, lineal color"

"Horse eating a hotdog, minimal 2D vector art, lineal color"

"A luxury boat, minimal 2D vector art, lineal color"

"A fluid simulation, minimal 2D vector art, lineal color"

"The space between infinity, minimal 2D vector art, lineal color"

"A torii gate, minimal 2D vector art, lineal color"

"An elephant surfing, minimal 2D vector art, lineal color"

"A spaceship flying in a starry sky, minimal 2D vector art, lineal color"

"Enlightenment, minimal 2D vector art, lineal color"

"Third eye, minimal 2D vector art, lineal color"

"A baby penguin and a polar bear taking an impossible selfie, minimal 2D vector art, lineal color"

"A plate of healty fast Food, minimal 2D vector art, lineal color"